Although the mitosis in the antheridial cells of *Polytrichum* agrees in general with that in higher plants, certain peculiarities are pointed out which may prove to be of phylogenetic significance. Such are the delay in the preparation of the nucleus for division until after the formation of the spindle rudiment, the great swelling of the nucleus in one dimension during the prophases, the equatorial aggregation of the chromatin following the swelling, and the final shrinkage of the nucleus. It is yet too early to say whether any or all of these features are generally characteristic of mitosis in bryophytes, but many fragmentary observations make this appear quite possible.

The comprehensive review of cytological work in the bryophytes and the extensive list of literature brought together contribute much toward rendering this paper of the highest value to students of cytology.—LESTER W. SHARP.

Mallow rust.—In an elaborate paper ERIKSSON[7] gives the results of many years' investigations on the mallow rust, which, coming originally from South America, has been introduced into Europe, North America, and other countries. The work is replete with experiments and observations covering all phases of the biology and life history of this fungus, which presents peculiar features of interest, first, because in the countries into which it has been introduced it has spread to many plants not native in its original habitat, and second because, being one of the lepto-Uredinales whose teleutospores germinate at maturity, its manner of living from season to season has not been satisfactorily explained. It is in fact this latter phase of the subject which forms the pivot of ERIKSSON's investigation, and upon which he brings to bear the results of a vast amount of painstaking work.

The main contentions of ERIKSSON are that the fungus persists in the seed of infected plants in the form of a mycoplasma, and that it is disseminated chiefly by means of infected seed. The mass of experimental and observational data upon which he bases these contentions are briefly summarized here.

The historical data relating to the distribution of the fungus show that in many places it was first observed on plants grown from seed obtained from infected nurseries. The fungus is not spread to great distances by means of the sporidia. Wide dissemination is brought about by means of infected seeds or seedling plants containing the fungus in the mycoplasma stage. In plants grown from infected seeds the first outbreak of the disease occurs regularly when the plants are about three months old. This period is required for the mycoplasma to change into the filamentous stage and produce spore pustules. The pustules of the primary outbreak are very numerous and are uniformly scattered over the leaves of the young plant, while those of the

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[7] ERIKSSON, J., Der Malvenrost (*Puccinia Malvacearum* Mont.), seine Verbreitung, Natur, und Entwickelungsgeschichte. Kungl. Svensk. Vetensk. Handl. **47**: 5–120. *pls. 6. figs. 18.* 1911. For summaries previously published by the author see Compt. Rend. **152**:1776–1779. 1911, and Centralbl. Bakt. **31**:93–95. 1911.

secondary infection from sporidia are localized in groups near the points of infection. Neither the mycelium nor the spores survive the winter in Sweden. The teleutospores of this rust are of two kinds, and although they are morphologically indistinguishable, they behave differently on germination. Those of one type produce promycelia and sporidia in the usual way, but those of the second type produce slender germ tubes, whose terminal portions break up into several independent cells or conidia. The sporidia put forth germ tubes, which, penetrating the epidermis, make their way through the epidermal cells either directly into the intercellular spaces or into the palisade cells, and thence into the intercellular spaces. New sori result from these infections in 8–15 days. The conidia germinate, so to speak, by pouring their content into the epidermal cells, from which it migrates into the palisade cells, and finally through the entire plant. No outer visible sign results from these infections. The protoplasm of the fungus enters into a state of symbiosis with that of the host, thus forming the mycoplasm. The seeds of such infected plants produce seedlings in which the latent fungus manifests itself by a general outbreak of sori over the entire plant when it is about three months old. The change of the mycoplasm into mycelium is similar to that process described by the author in former papers.

Two other papers published shortly before the appearance of ERIKSSON'S account treat briefly of the mallow rust. In the first of these TAUBENHAUS[8] describes the two modes of germination of teleutospores noted by ERIKSSON, but, unlike ERIKSSON, he finds that the "conidia" abjointed by some of the germ tubes produce sporidia like other promycelial cells. Furthermore, he finds that the fungus is carried through the winter both by hibernating mycelium and by teleutospores. In plants in protected places, the mycelium resulting from late infections appears to produce sori, which develop slowly during the winter and mature the following spring. Regarding the hibernation of teleutospores, TAUBENHAUS finds that the teleutospores formed late in the season seem to behave like those of a *micro-Puccinia*. Some of these he found capable of germination during the winter and spring. With the advance of the season, however, the time required for germination increased from 24 hours to 6 days. This observation is quite contrary to the experience of DIETEL, who found that the period required for the germination of the teleutospores of *Melampsora Larici Caprearum*, a form with hibernating teleutospores, decreased with the advance of the season. Young seedlings may be infected by teleutospores borne in sori on the carpels and involucral bracts. Thus the fungus is distributed by means of infected seed and pieces of involucral bracts mixed with the seed, although the embryo is not infected.

In the second paper DANDENO[9] gives brief additions to his formerly

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[8] TAUBENHAUS, J. J., A contribution to our knowledge of the morphology and life history of *Puccinia Malvacearum* Mont. Phytopathology **1**:55–62. *pls. 3.* 1911.

[9] DANDENO, J. B., Further observations on the life history of *Puccinia Malvacearum*. Rep. Mich. Acad. Sci. **12**:91, 92. 1910.

published observations on the mallow rust. According to him the mycelium of the fungus lives through the winter in the stems and petioles of *Malva rotundifolia*, but the teleutospores do not survive the winter in Michigan.

Although ERIKSSON'S observations have added many facts to those already known of the general biology of the mallow rust, his conclusion that the fungus lives through the winter only in the form of a mycoplasma in the seed or young plant is largely inferential, and one is inclined to give preference to the explanations of TAUBENHAUS and of DANDENO as less at variance with general experience than is the mystical mycoplasma.—H. HASSELBRING.

Germination.—The irregularity of the differences in rapidity and percentage of germination in the unlike seeds of heterocarpic plants under various conditions of germination, when the fruit and seed coats are left intact, is well shown in a lengthy paper by BECKER,[10] who studied in a rather superficial way the germination of 47 species of Compositae, several Cruciferae, and three Chenopodiaceae. Morphological position, the sexual condition of the flowers, darkness, temperature, increased and decreased oxygen pressure, nitric acid, and Knop's solution influence now disk seeds, now ray seeds, or both, or neither according to species, apparently without regularity. Age and possible sterility of the seeds are disturbing factors in the results. Most of the experiments were performed with fruit coats intact, but enough were removed to prove that the inclosing structures are largely responsible for these differences, which always become much less on removal of the fruit coat. These differences in germination do not, therefore, as ERNST and CORRENS assumed, rest on differences in the constitution of the embryos. This fact has been recognized here for some years, but has not been properly recognized abroad. Embryos of dimorphic seeds may and do differ, as the reviewer has shown[11] for *Xanthium;* but the differences due to embryos alone cannot be determined with seed coats left on the seeds. With *Axyris amaranthoides* BECKER does not get total failure of the round seeds to germinate, as did CROCKER[12] with seeds of this plant from our northwest, but merely a very low germination. This may be due to ecological differences in the regions where the plants grow affecting the seed coats.

As to the influence of increased oxygen, BECKER finds that brief exposure of seeds brings about the same kind of response as continuous exposure to high oxygen pressures, and argues therefrom that it exerts a chemical stimulus upon the protoplasm of the embryo, rather than increases the respiration as CROCKER has suggested. BECKER does not tell us what is the difference

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[10] BECKER, HANS, Über die Keimung verschiedener Früchte und Samen bei derselben Species. Inaug. Diss. pp. 7–129. 1912.

[11] SHULL, CHAS. A., The oxygen minimum and the germination of *Xanthium* seeds. BOT. GAZ. **52**:453–477. 1911.

[12] CROCKER, WM., Rôle of seed coats in delayed germination. BOT. GAZ. **42**:265–291. 1906.